Consúltese el estudio "Shipbuilding and Shipping: The Year the Century" en "The Shipping World" — January 2, 1901 — pág. 9.

la obra "Cross-Channel and Coastal Paddle Steamers" por Frank tt. — Londres: Richard Tilling, 104, Great Dover Street, S.E.1. — 440 págs (illustrated) — 15 s. (net). ("S. & S. Record" — 13 Marzo 1934).

El "Mary Powell" (vapor de ruedas) fué desde New York a Albany, por el Hudson, ya en 1867, a una velocidad de 23 millas por hora. (id. id.)

Vide la obra "Steam Packet" por David Mathew. — Londres: Longmans, Green & Co. Ltd.: Paternoster Row, E.C.4 — 148 págs. — 6 s. (net).

125 años de navegación a vapor en el río Elba. — nota en "Rev. Gral. Marina" — septbre. 1941, 479.

"The First Naval Steamers" — largo artículo de H.W. Brady, M.I.Mech.E. en el nº extraordinario de "The Syren & Shipping" — 4 enero 1956, pág. 17. ~

THE EARLY HISTORY OF STEAM NAVIGATION.

MUSEO MARITIMO BARCELONA

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BY

GEO. W. BUCKWELL, M.I.M.E.

(WHITWORTH SCHOLAR),
BOARD OF TRADE SURVEYOR.

Reprinted from "The Steamship."

"A Short History of Naval and Marine Engineering", por Edgar Smith, Engineer-Captain, O.B.E., R.N.

Artículos acerca del desarrollo de la navegación a vapor en Europa, Asia y Africa, por Rafael Cotta Pinto — "Oficema" — Junio-Agosto- (precaución).

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Navy Engineering Sixty Years Ago. — "The Engineer„, 20 Nov. 1936 — y 27 id. id. Hacia 1874 y coincidiendo con la subida al Poder del Gobierno Disraeli, se produjeron en la Armada inglesa una larga y del todo desusada serie de desastres. "The "Iron Duke„ collided in a fog with, and sank, the "Vanguard„; there was a disastrous boiler explosion in the "Thunderer„; a stop valve exploded in the "Hydra„; a compressed air chamber blew up in the "Vesuvius„; the engines of the "Shah„ failed to work satisfactorily in service. A gas explosion in the bunkers of the "Devastation„, and the "Alexandra„, possibly the most powerful man-of-war then afloat, had returned from her first trial trip with a defective crank pin.„ (En "The Engineer„ de 9 abril 1937, se recuerda la historia, casi trágica, del H.M.S. "Tourmaline„ (corbeta de hélice, de 1864 ton. 1.972 IHP.) que entró en servicio en octubre de 1876 y fué enviada a la Estación de la Costa W. de Africa. Su viaje fué penosísimo; con incontables averías en las calderas y en la máquina. Tan grandes fueron los trabajos y contrariedades, que el maquinista-jefe se perturbó y hasta intentó suicidarse, y aunque esto se pudo evitar, la ansiedad y agotamiento hicieron presa en él y murió pronto y tras breves días de gravedad.) — En años anteriores las máquinas a vapor para los barcos de guerra ya se habían proyectado y construido con suma liberalidad, sin trabas, y por más que las cámaras de máquinas y calderas no fueron objeto de sistemáticas reducciones o limitaciones; no obstante, el aumento en las dimensiones de las máquinas y aparatos generadores del vapor no guardó perfecta correspondencia con las de los departamentos en que habían de instalarse. Cuando Mr. E. J. Reed fué nombrado Chief Constructor las cosas mejoraron; puesto que este gran arquitecto naval redujo, en general, la eslora de los barcos de combate; pero, en cambio, aumentó mucho la manga. Otra fuente de accidentes en la maquinaria de los buques de guerra durante aquellos años fué, sin duda, el muy frecuente traslado, de unos barcos a otros, del personal directivo de máquinas. También pudo contribuir la falta de un maquinista-jefe supremo del ramo dentro de la Armada británica. En aquella época había en cada uno de los principales puertos militares un maquinista-director; pero no existía entre ellos la necesaria coordinación.

W. AND J. M'KAY, PRINTERS, LEITH.

El primer vapor que hubo en la Armada española con máquina construida en España fué el "Liniers„, de 120 caballos y que aparejaba de goleta. El casco se construyó en Cartagena, y la máquina en los talleres Vulcano, de Barcelona; donde hizo sus pruebas, al mando del teniente de navío D. Jorge Fuster, desarrollando 11 nudos. ("Rev. G. Marina„, mayo 1941 — p. 787)

En 1942 se cumplió el centenario del primer viaje alrededor del Globo de un barco de guerra inglés movido por el vapor; aunque, claro es, era un buque-mixto o a vela y vapor. Fué éste la corbeta de madera, con seis cañones y movida por ruedas de paletas, nombrada "Driver„; la cual fué construida en el arsenal de Portsmouth en 1841. = A la fragata inglesa, de 50 cañones, "Constance„, de 1846, se le instaló en 1865 la primera máquina compound que se usó en la Armada Real Británica, logrando reducir el consumo de carbón a 2'51 libras por cab.-indicado-hora; en vez de 3'17 y 3'64 que consumían los barcos similares, pero con máquinas sencillas o de simple expansión. — Pueden verse estos y otros detalles en el artículo (ilustrado) "A Century of Naval Engineering„, por Frank C. Bowen, en "Shipbuilding and Shipping Record„, nº 12 marzo 1942, pág. 328.

Algo de biografía y de la influencia que el ingeniero maquinista inglés José Bramah (1749-1814) tuvo en la maquinaria de los buques, en la determinación de las ventajas de la hélice propulsora, etc.: "The Syren and Shipping„, 29 abril de 1942, pág. 119.

En la pág. 145 del nº 6 mayo 1942 de "The Syren and Shipping„ hay un artículo titulado "The historian of steam„ que empieza así: "Robert Stuart's Descriptive History of Ste Engine and his Historical and Descriptive Anecdotes of the Steam Engine world, if pr duced to-day, rank as valuable books of their intrinsic merits, and particularly th of accuracy. In the early 'eighties, when they were actually published, they were very remarkable books indeed, being of that kind which does not cater for a public taste but creates it. They were soon universally known, but as works to be read by engineers they have been largely superseded by the histories of Thurston and, subsequently, of Dr. H W. Dickinson. The later and Mr. A. A. Gomme have, in a paper before the Newcomen Society, recently shed much light on "Robert Stuart„, who was really Robert Stuart Meikleham. . . . „ (prosigue

~ Acerca los orígenes de la navegación á vapor consúltese: hoja nº 31 de "La Marina Ilustrada (II parte, A)„; "The Shipping World„ de 2 Enero 1901, artículo "The Year and the Century„

~ Consúltese una nota sobre los primeros vapores trasatlánticos, en "Ibérica„, nº 274 – 19 Abril 1919 – pág. 245.

~ Breve reseña histórica acerca de la propulsión de los barcos de guerra – en la revista "Ingeniería Naval„ – nº Julio 1931.

THE EARLY HISTORY

~ Steam boat "Novelty„ (uso de la antracita como combustible – 1836), "Shipbuilding & S. R.„, 19·IX·1936, 326.

~ El 21 de diciembre de 1736 un relojero de Gloucester, Jonathan Hulls, recibió del rey Jorge II la patente para construir un barco a vapor: breve nota en "S. & S. R.„ – 31 diciembre 1936, p. 790.

OF

STEAM NAVIGATION.

MUSEO MARÍTIMO BARCELONA

PERIOD I.

From the Earliest Accounts to the Invention of the Separate Condenser.

HISTORY repeats itself, hence historical narration never contains anything new; and with the marine engine in particular, it has been so dependent in its early stages on the improvements first effected on land, that a history of it is bound to include to some extent an account of the works of those inventors not in the least connected with it.

Leaving myth and vague notions out of the question, the first reliable attempt at steam navigation that we have any account of took place in 1543. On the 17th of June in that year, Blasco de Garay, a Spanish naval X officer, exhibited before the Emperor and Court of Spain a vessel of 200 tons, which was propelled by paddle

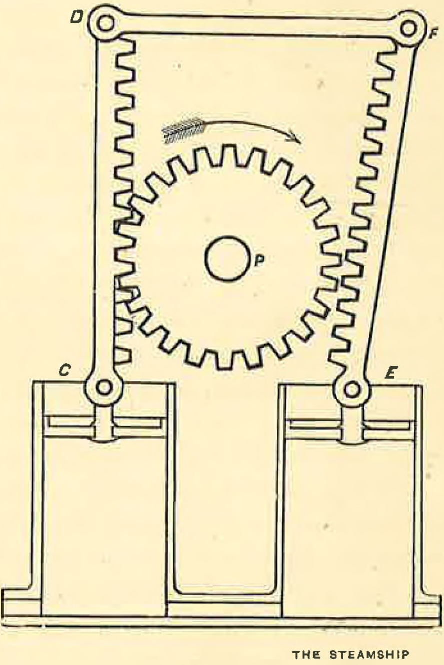
X La realidad de este suceso, de este ensayo que no atrajo la atención y el interés de los españoles, se menciona aquí respetuosamente, y de él se ocupa con acierto la "Enciclopedia Espasa-Calpe„ en el artículo sobre el VAPOR y sus aplicaciones.

wheels at the rate of three miles an hour. The experiment took place at Barcelona, and various opinions have been advanced as to how the steam may have acted, but nothing certain is known, except that the moving force was derived from a boiler containing water, which was liable to cause an explosion; hence it may be concluded that either the boiler was weak through being of unsuitable form or material, or else that a comparatively high pressure of steam was used. Probably the engine was only a copy of Hero's on a much larger scale, that of Hero having been but a mere toy. The result realised by Garay was an entirely successful one, and he was rewarded by the Emperor, Charles V.; but no further steps were taken in the matter, so his ingenious plan of navigation fell through for the time being. Forty-four years later, however, Paucerollus speaks of vessels driven by paddle wheels, thus indicating that the ideas of Garay had not been entirely forgotten.

During a period of sixty years in the seventeenth century—that is, from Ramsay in 1618 to Bushnell in 1678—various inventors proposed the propelling of vessels without sails, and against wind and tide, but no practical results appear to have ever been attained. The names of Grant, 1632, and the Marquis of Worcester, 1655, are the best known of these enthusiasts, but taking into account their designs for land engines, it is exceedingly improbable that their marine engines were any improvement on Garay's.

The first actual inventor of a marine steam engine was Dr Denys Papin, a Frenchman, and a short notice of him will explain wherein his genius improved the water-raising machines of his time, and developed them into actual engines. He was born at Blois in 1647, studied medicine at Angers University from 1662 to 1669, when he obtained his degree of Doctor. In 1671 he was appointed curator in the Experimental Laboratory of the French Academy, and in 1674 appeared his first memoir on "Vacuum," detailing his experiments made on that subject. From 1675 to 1679 he was in London, working part of the time as an assistant to Boyle, and part as amanuensis to the Royal Society; and Papin is credited with the invention of the double air-pump usually ascribed to Boyle. In 1680 he was elected F.R.S., in 1684 appointed curator to the Royal Society, and twelve months later he turned his inventive genius to the improvement of the imperfect engines that were in use at that period. His chief inventions were a pneumatic engine for raising water, 1685; a vacuum engine for mine pumps, 1687; and a gunpowder engine for creating the vacuum, 1687—each one being an improvement on the last. He was appointed Professor of Mathematics at Marburg University in 1688, where he improved his engine into a gunpowder and air engine, and finally in 1690 into a steam and air engine, or, as it is called in modern phraseology, an atmospheric engine. The top of the cylinder was open, steam being employed to raise the piston, then condensed to form a vacuum, when the pressure of the air on the top of the piston depressed it. To adapt this engine to the propulsion of vessels, he in 1691 proposed to use two cylinders (see Fig. 1), the piston-rods being jointed to racks, arranged to gear alternately with a pinion on the paddle shaft. Both pistons rose and fell together, but on the upstroke the rack C D geared with P, the rack E F being out of gear, and on the downstroke E F geared with P, and C D was thrown out of gear, thus making the motion continuous in the direction of the arrow. Papin was also the inventor of the lever safety-valve, the piston, and the flue boiler. In a sketch of his steamboat by Figuier, the

Fig. 1.—Papin's Engine.



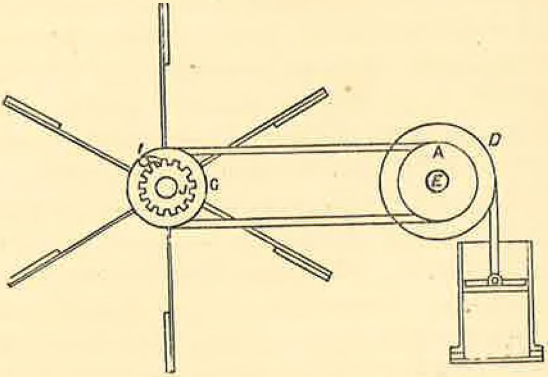
engine is represented as a Newcomen engine driving a pair of wheels of six floats each; but this no doubt is imagination, as the "walking beam" was not invented till 1712, or 17 years later; the method, however, of using the steam was essentially the same as that adopted by Newcomen. In fact, Papin seems to have been the experimenter, and Newcomen the practical adapter, only he did not devote his attention to the propulsion of vessels. In 1695 Papin was appointed engineer to the Landgrave of Hesse at Cassel, and in 1707 he built a steamer on the Fulda with the intention of taking it to London; but having to obtain permission of the river authorities to sail it beyond Hessian terriority, and failing to do so, it was hauled up on the bank and broken in pieces by the river bargemen. It is often the fate of experimenters who do not succeed to be called dreamers, and Papin shared that fate. Newcomen adopted Papin's ideas and was successful, hence he is spoken of as a great inventor.

In 1698 Savery brought into use the injection condensing spray, now known as the common jet or jet injection, only he applied it inside the steam cylinder, as the separate condenser was not invented then. Previous to 1705 the cylinder had always stood on the top of the boiler, but in that year Newcomen separated them and kept them distinct; he also added the feed-pump to the engine. The steam and water taps were all hand-worked till 1716, when Humphrey Potter, one of the attendant boys, conceived the idea of connecting them to the walking beam, and Beighton in 1718 greatly improved this ingenious self-acting valve-gear.

Hooke in 1680, and Duguet in 1727, suggested the use of the screw-propeller, and in 1730 Dr Allen proposed a hydraulic propeller, a jet of water being forced through the stern of the vessel below the water level, the reaction thus moving the vessel ahead. To Allen is also due the conception of the tubular boiler and forced draught, but the only means at his disposal to carry it out was a bellows-blast. Allen's propeller was tried in a small boat on a canal, the pumps being worked by hand; but he suggested its application to a large steam vessel. The success was such that David Ramsey in 1738 patented the hydraulic propeller.

Jonathan Hulls in 1736 patented a method of propelling a vessel by steam for towing purposes, and in 1737 published a pamphlet describing his patent. He used Newcomen's atmospheric engine, working a ratchet by means of cords and pulleys, weights being used to keep the rotary motion continuous on the return stroke of the piston; a single paddle wheel of six floats was placed at the stern, " that being the proper place for it, because waterfowl pushed their web feet behind them." The piston (see Fig. 2) was connected by a cord to the pulley D, that and the pulley A being keyed on the shaft E. An endless cord passed from A to the pulley G, which was loose on the paddle shaft. A paul I was fixed on this last pulley, gearing into the toothed wheel J keyed on the shaft. On the downstroke of the piston the arrangement moved the paddle wheel, and on the upstroke a weight connected to another pulley and ratchet on the paddle shaft kept the wheel moving. It is a wonder that Hulls did not employ two cylinders, one piston making its upstroke whilst the other made its downstroke; the weight could then have been discarded; as he described it, it was an inferior arrangement to Papin's. In shallow waters he used grasshopper legs in place of the wheel; the paddle shaft was replaced by a double cranked axle, and to each crank was connected a long pole reaching the river bottom, the navigation being performed in the same way as the modern bargee propels his craft. This was the first time on record that a crank axle was used in connection with the steam engine.

FIG. 2.—HULLS' ENGINE AND WHEEL.



THE STEAMSHIP

Bernouilli in 1752 proposed an artificial fin as a propeller, on the principle of a windmill vane, to be worked by steam; and Genevois in 1760 suggested an idea that was carried out by Jeuffrey twenty years later. As an improvement on Papin's and Hull's methods of obtaining rotation, Professor Fitzgerald in 1757 added the fly-wheel; it was immediately adopted on land engines, and has ever since formed an integral part of them.

To James Watt is due the credit of having transformed the old atmospheric engine into its modern type of the steam engine. Smeaton had collected data, doubled its efficiency, and brought its proportions to as near perfection as could be done; but while he was thus engaged, Watt had been investigating its principles, and the conclusion at which he arrived in 1765 summed up the whole theory of the steam engine: it was, "that to make a perfect steam engine, it was necessary that the cylinder should be always as hot as the steam which entered it, and that the steam should be cooled down below 100° in order to exert its full power." To carry out this theory he invented the steam-jacket to keep the cylinder hot, the separate condenser placed in a tank of cold water to cool the steam down, and added the air-pump to keep the condenser clear; in 1769 he patented this addition to the single-acting engine. Sir Samuel Morland in 1680 had invented the stuffing-box and gland; Watt incorporated this into his engine, and in 1782 transformed it into the double-acting engine.

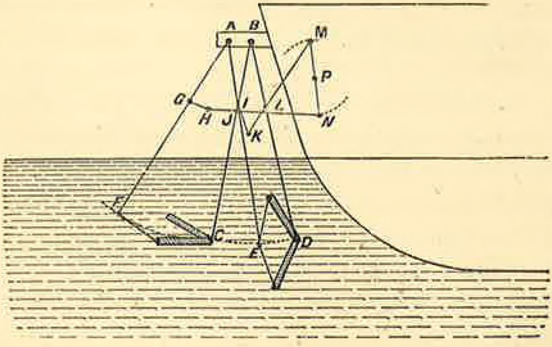
Smeaton and Watt may be compared to Papin and Newcomen; Smeaton, like Papin, was the collector of ideas, and Watt, like Newcomen, was the practical adapter of them. Each one was dependent on what his predecessor had done; Papin was the actual inventor of the modern engine, Newcomen and Smeaton improved it, and Watt brought it to perfection.

-Puede consultarse un articulo a propósito de las primitivas locomotoras en el nº de
he Syren and Shipping" de 24 diciembre 1947, pág. 407.

During the period of Watt's investigations, other engineers were also engaged in improvements in the marine engine. In 1774 Perrier constructed a small paddle wheel boat, and navigated it on the Seine; in 1768 Pancton, and in 1776 Bushnell, proposed screw propellers, the latter also suggesting a reversing motion, that the boat might be driven astern if required. In the same year Wasbrough proposed high-pressure engines for propelling ships, but his idea was only Hulls' and Fitzgerald's methods combined. In 1780 Pickard patented the present arrangement of connecting rod and crank. There must have been some very peculiar defect in the English patent law at that date to allow such an arrangement to be patented, for, as Watt said, "The true inventor of the crank rotative motion was the man, whose name unfortunately has not been preserved, who first invented the common foot lathe. The applying to the steam engine was merely taking a knife to cut cheese which had been used to cut bread." Knight, in his Mechanical Dictionary, does not once mention Pickard's name, and says "It would be a pity to embalm the name of a scoundrel by recording it." In 1781 the Marquis de Jeuffrey carried out Genevois' idea of a waterfowl's foot propeller (see Fig. 3): M N was a beam oscillated by a two-cylinder engine about the centre P; A and B were the centres of oscillation of four rods A G F, A I E, B J C, and B L D; to M and N were connected the links M L K and N J H, jointed to rods B J C and B L D at J and L respectively, but connected to rods A G F and A I E by swinging links

G H and I K. As the beam M N oscillated, the fowl's feet moved backwards and forwards, being opened on the stern stroke and closed on the head stroke. Jeuffrey tried this arrangement in a boat 140 feet long and 15 feet beam on the Saone. A year later James Rumsey used a hydraulic propeller on Potomac; a vertical pump two feet diameter in the middle of the vessel was worked by a steam engine, the water being drawn in at the bow and expelled at the stern through an orifice six inches square; she was 80 feet long, and went four miles an hour. In 1785 Bramah patented a rotatory engine fixed on a screw propeller shaft. In 1786 Oliver Evans devoted his energies to improving Rumsey's propeller, and used high-pressure steam, but he was derided as a lunatic for doing so. Fitch, in the same year, paddled a ship by steam by means of oars, six-a-side,

Fig. 3.—Jeuffrey's Propeller.



THE STEAMSHIP

worked by a crank arrangement, three oars on each side being in the water at once. In 1788 he made a public trial on the Delaware, and realised eight miles an hour, the engine having a twelve-inch cylinder and three-feet stroke, but unfortunately burst his boiler. Ultimately he drowned himself in despair.

Watt's improvements were generally known about this time, and hence the engines employed in steamboats came to be of the modern class, fitted with condensers and air-pumps, a description of which falls into another period of the history of steam navigation.

The following table gives particulars of the proposals in connection with the marine engine during its earliest period:—

Name.	Date.	Style of Engine.	Propeller.
Garay	1543	Aeolipile	Side paddle
Hooke	1680	—	Screw
Papin	1695	Rack and pinion	Side paddle
Papin	1707	—	Side paddle
Duquet	1727	—	Screw
Allen	1730	Hand	Hydraulic
Hulls	1736	Ratchet	Stern paddle
Hulls	1737	Ratchet	Grasshopper legs
Bernouilli	1752	—	Artificial fin
Genevois	1760	—	Duck's foot
Pancton	1768	—	Screw
Perrier	1774	—	Paddle
Bushnell	1776	—	Screw
Wasbrough	1776	Ratchet	Stern paddle
Jeuffrey	1781	Two cylinders	Duck's foot
Rumsey	1782	—	Hydraulic
Bramah	1785	Rotatory	Screw
Fitch	1788	—	Oars

PERIOD II.

From the Invention of the Separate Condenser to the Performance of the First Ocean Voyage.

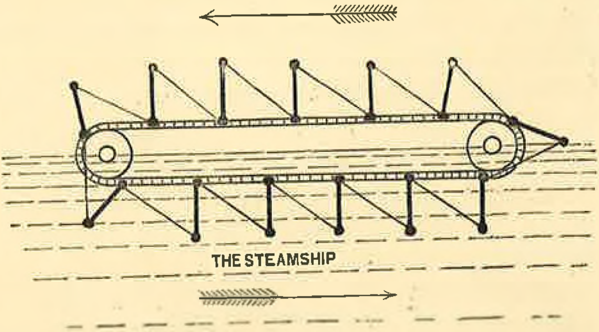
WATT'S invention of the double-acting engine and separate condenser rendered the engine more regular and certain in its action, and with that invention commenced the real era of steam navigation, as indeed that of steam locomotion, and its profitable employment on land also.

The Marquis de Jeuffrey's duck's foot propeller proving unsatisfactory, he turned his attention to another propeller, viz., the paddle wheel. No doubt he was acquainted with the former experiments of his countryman, Papin, as also those of the various English idealists, and founded his new ventures on their failures. In the middle of the year 1783 the second public trial of Jeuffrey's steamboat took place at Lyons, with a result so successful that he applied to the French Academy to indorse it, as had been promised, and also to the French Government for a monopoly of steam river navigation, in accordance with a guarantee promised ten years before. The propelling machinery consisted of a Watt engine on Papin's rack system, but it was placed horizontally instead of vertically; the idea, however, was exactly the same as Papin's of ninety years previous. The boat was 10 ft. longer and one foot wider than the one used with the duck's foot arrangement, and of 3 ft. draft, the paddle wheel being 14 ft. diameter. In spite of its great success the French Government declined to guarantee the monopoly, and Jeuffrey became so discouraged that he lost all hope, and gave up prosecuting his plans any further. Papin was a Frenchman and the inventor of the modern piston and cylinder engine; Jeuffrey was a Frenchman and the first engineer to make a paddle-wheel steamboat successful; but what has France gained by the efforts of these two great men? She neglected them, and allowed other countries to profit by their ideas and inventions, and has thus twice lost an honour that she would now be glad to lay claim to! But the whole of that honour has fallen to the share of Great Britain and the United States.

John Fitch, the Connecticut mechanic, and Richard Trevithick, the Cornish mine captain, seem to have been remarkably alike in temperament. Both were full of ideas, but before one could be successfully carried out another was started upon, the result being that it was a case of two stools, and nothing came of either. Neither Fitch nor Trevithick could bear the thought that some one else was working in the same direction as themselves, and both were terribly disappointed on hearing of other people's successes where they themselves had failed, although that failure was entirely due to overhaste.

Fitch's first boat in 1785 was propelled by an endless chain and floats (see Fig. 4); his second boat in 1788 was propelled by side oars, as previously described; his third boat in 1788 was propelled by three oars placed at the stern, moved by a beam engine with an 18 in. cylinder and 3 ft. stroke, the proportion of the beam to the length of the boat being 1 to $7\frac{1}{2}$, whereas his second boat had been much bluffer, being only 1 to $3\frac{3}{4}$; a fourth boat in 1790 on the same model as the third realised seven miles an hour, and was used for passenger carrying at Philadelphia; a fifth boat in 1796 was propelled by a screw.

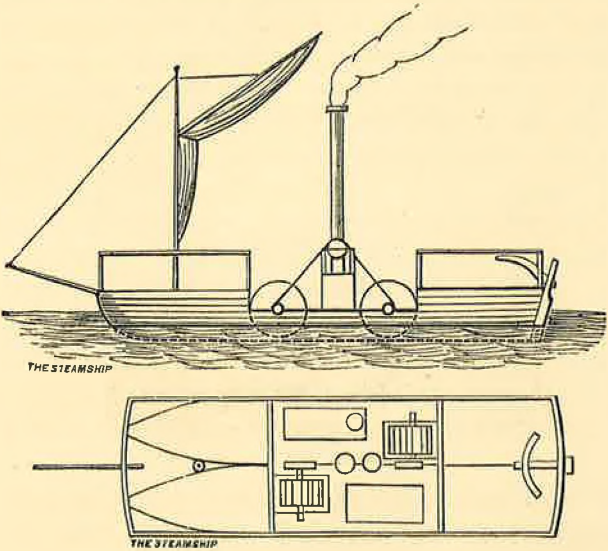
Fig. 4.—Fitch's Chaplet.



Trevithick was not contented with low-pressure steam, he was the apostle of high-pressure engines, and as such was the actual inventor of the modern locomotive and steam launch; but being unsuccessful he was classed, like Papin, among the dreamers. His first proposal for a marine engine was in 1804, the idea being to fit a fireship with one to propel her to Boulogne and there destroy the French fleet. In the same year he fitted a high-pressure steam-puffer in an ordinary canal barge at Coalbrookdale, and propelled her seven miles an hour. In 1806 he designed a centre paddle-wheel steamer of 100 tons, having a 12 horse-power engine, and a wheel 14 ft. diameter. Two years later he designed a side-wheel steamer of peculiar form, very similar to a steamer built only a few years ago for a foreign potentate. She was saucer-shaped, having portions of the sides cut away for the wheels, and driven by two cylinders 42 in. diameter by 8 ft. stroke, the diameter of the wheels being 25 ft. 6 in. He also proposed the use of the screw propeller, but that will be referred to later on.

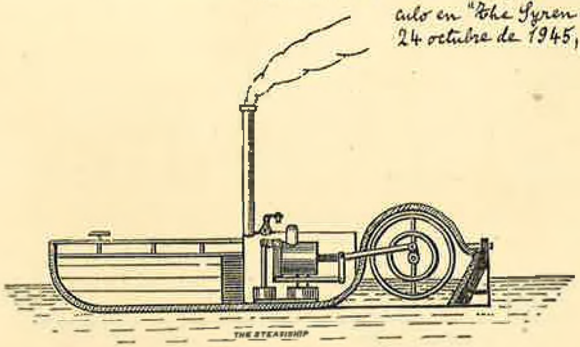
During a period of five years towards the end of the eighteenth century, 1786 to 1791, Patrick Miller of Dalswinton, a Scottish gentleman, spent more than £30,000 in experiments on coast defences, including the use of steam for navigating purposes. The carronade was his invention, as also the use of double hulls and twin keels. In 1787 a twin-keeled boat, 60 ft. long and 15 ft. beam, constructed on his plan, realised a speed of four miles an hour, the paddle wheels being driven by a capstan worked by five men. William Symington, a far-ahead genius of the time, and a friend of James Taylor, the tutor to Miller's children, designed an engine, from which the later side-lever form originated. Miller had a pair of these engines placed in the "Dalswinton" for a trial on his loch in 1788 (see Fig. 5). The "Dalswinton" was a double boat, each 25 ft. long by 7 ft. beam, placed side by side and decked over, the two cylinders being 4 in. diameter by 18 in. stroke, the pistons connected below to an oscillating lever, and above to chains working a ratchet on an intermediate shaft, this latter being connected by endless chains and pulleys to the paddle shafts. It will thus be seen that the idea was a somewhat similar one to Hulls' of 1736, but he dispensed with Hulls' weight by using two cylinders. This boat ran four miles an hour. A second boat, the "Carron," was built in 1789, 60 ft. long, and driven by engines 18 in. diameter by 3 ft. stroke, but through a mistake in the design of the paddle wheels they were not strong enough, and broke down; on stronger wheels being

Fig. 5.—The "Dalswinton."



fitted she ran seven miles an hour on the Forth and Clyde Canal. It appears that Miller was dissatisfied with the style of engine, and refused to make any more experiments with it, so Symington altered the design considerably, and twelve years later he managed to secure another patron, Lord Dundas of Kerse, for whom a steamer was built at Grangemouth in 1801. This boat, named the "Charlotte Dundas," out of compliment to his lordship's daughter, was, as regards its engines, to all intents and purposes exactly similar to the high-speed direct-acting paddles of the present day, and Symington is therefore entitled to the honour of having designed and brought into use the "parent boat" of modern paddle navigation. She was 56 ft. in length, 18 ft. in breadth, and 8 ft. in depth, with a paddle wheel at the stern. There are sketches of this boat in three well-known books, but they all differ; the most reliable, however, gives a wheel about 10 ft. diameter (see Fig. 6).

FIG. 6.—THE "CHARLOTTE DUNDAS." ~ Puede consultarse un artículo en "The Syren and Shipping", nº 24 octubre de 1945, pág. 121. ~



The cylinder was horizontal, 22 in. diameter by 4 ft. stroke, and coupled direct to the paddle shaft crank by a connecting-rod about 8 ft. long. The condenser was immediately beneath the cylinder, and the air-pump a little farther forward, worked by a draglink and bell-crank, the same as modern paddle steamers with fixed cylinders. A speed of about six miles an hour was attained on her trial, and on a later occasion she towed two sloops, each of 70 tons, from Wynford to Port Dundas, against a strong head wind, at 3½ miles an hour. Lord Dundas was a large shareholder in the Forth and Clyde Canal, and used his interest in aid of the new method of towing, but the proprietors, after twelve years' trial (!), fearing injury to the banks from the wash of the water, interdicted its use, and the boat was laid up at Brainsford for years. The Duke of Bridgewater had promised his influence to Symington, but the Duke's untimely death prevented the carrying out of his intention. James Taylor, for his aid in introducing steamboats, received a pension of £50 a year, and each of his four daughters received £50 as a gift; but poor Symington only got £150 altogether, and that only after many earnest appeals by his friends. He died in London, a pauper, in 1831.

In this connection some of James Watt's letters may be referred to. A friend of Symington's had written to Boulton and Watt at the time of the Forth and Clyde Canal experiments, but Watt answered in a very unsocial manner. He first accused Symington of trying to overreach his patents, and was certain he would not succeed;

afterwards on hearing of his success Watt said he was very pleased, but it was nothing more than he had expected from one of his own (Watt's) engines.

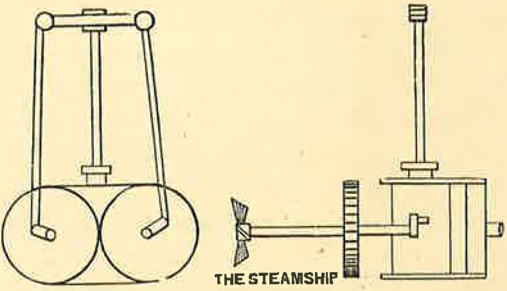
During Miller's and Symington's experiments, various believers in steam navigation on the other side of the Atlantic had been at work, chief amongst whom may be mentioned Fulton and Stevens.

Robert Fulton was born in 1765 ; at fourteen years old he commenced his experiments, although learning the trade of a watchmaker at the time ; eventually he chose the profession of a painter, and proceeded to England on coming of age to study under Benjamin West. He gave up his profession and turned to engineering for a livelihood when 28 years old ; in 1793 he proceeded to France and experimented on subjects connected with submarine warfare ; in 1802 he went to Scotland, and Symington got up steam specially in the "Charlotte Dundas" to give him a trial trip of eight miles up the Forth and Clyde Canal. Fulton returned to France and experimented on the resistance of fluids ; in 1803, in concert with Chancellor Livingston, he designed and had constructed a boat on the Seine, 60 ft. long by 8 ft. beam, but proving too weak for the machinery placed in it, it broke in two ; it was reconstructed and lengthened 6 ft., when a trial was successfully accomplished, a speed of four miles an hour against the current being maintained. A water-tube boiler was employed in this boat, having been patented in France by Barlow in 1793. Stevens patented the same thing in America in 1804, and Trevithick in England in 1815.

Fulton returned to England in 1804, and had a Watt engine built to take to America with him, whither he sailed at the end of 1806.

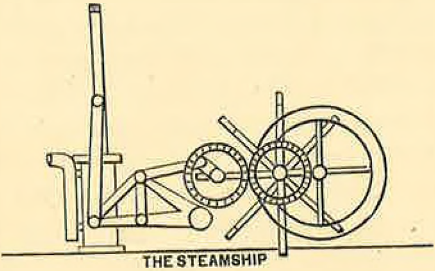
While Fulton was in Europe, Colonel John Stevens, of Hoboken, had constructed a direct-acting high-pressure condensing steam engine, and used it to drive both single and twin screws. In 1804 he built a boat 50 ft. long, the engine having a cylinder 10 in. diameter by 2 ft. stroke, using a single screw, and a water-tube boiler very similar to the modern "Field," the tubes being fixed at one end to the steam chest and plugged at the other, but lying nearly horizontal instead of vertical as in the "Field." In the following year he built a second boat, 68 ft. long and 14 ft. beam, somewhat larger than the first one, fitted it with the same engine driving twin-screws, and a larger boiler, and attained a rate of eight miles an hour with it (see Fig. 7). Colonel Stevens and his son Robert were engaged in the construction of a third boat, the "Phœnix," when Fulton

Fig. 7.—Stevens' Twin-Screw.



returned to America with his Watt engine. Immediately on his arrival he contracted with a shipbuilder on the East River at New York to build a boat to place it in; this boat, the "Clermont," was launched early in 1807, by the middle of the year her machinery was fitted, and in August she accomplished the passage from New York to Albany on the Hudson, 160 miles, at the rate of five miles an hour. A monopoly of steam navigation on the Hudson had been promised by the Legislature of New York to anyone who should accomplish the above distance in 36 hours, and Fulton succeeded in establishing his right to it by having performed the feat in 32 hours. The "Clermont" was 133 ft. long, 18 ft. wide, 9 ft. deep, and 160 tons burthen; her engine (see Fig. 8) consisted of one cylinder 24 in. diameter by 4 ft. stroke, driving paddle wheels 15 ft. diameter by a bellcrank and intermediate gearing. The bellcrank oscillated on its centre and had a counterweight, the connecting-rod continuing the motion to the gearing; a fly-wheel was also fitted to carry her over the dead centres.

Fig. 8.—Engine of the "Clermont."



Mr D. K. Clark, referring to Fulton, says :—" To him is due the credit of coming to England and carrying into practice, with the most beneficial results to mankind, a British combination neglected by the British nation. It is a singular yet melancholy fact, that at the same time the two most remarkable inventions of any age—practical steamboats and practical locomotive engines—were both lying for years as a reproach and a by-word on the highways of Great Britain—Symington's steamboat on the Forth and Clyde Canal, Trevithick's locomotive engine in a ditch by the roadside."

Speaking of the passage from New York to Albany, Professor Thurston says :—" This was the first voyage of considerable length ever made by a steam vessel, and Fulton is entitled to the great honour of having been the first to make steam navigation an every-day commercial success, and of having thus made the first application of the steam engine to ship propulsion, which was not followed by the retirement of the experimenter from the field of his labours before success was permanently insured."

After the above expression of opinion by two such eminent authorities it seems rather out of place for the late Scott-Russell to give all the credit of introducing steam navigation to Miller, Taylor, and Symington. Miller gave up on the eve of success, Taylor was not a practical engineer at all, but a theoretical man entirely, and Symington was unfortunately neglected by his countrymen and country. Fulton, undoubtedly profited by the labours of Fitch and Symington, and he would have been foolish not to have done so, but it must be remembered that he was closely pushed, at the time of his own experiments, by the two Stevens, and therefore greater credit is due to him for persevering as he did.

The "Clermont" used dry wood as fuel, and consequently an incessant flame protruded from her smoke-stack. "This uncommon light," says Thurston, quoting Colden, "first attracted the crews of other vessels. Notwithstanding the wind and tide were averse to its approach, they saw with astonishment that it was rapidly coming toward them; and when it came so near that the noise of the machinery and paddles was heard, the crews, in some instances, shrank beneath their decks from the terrific sight, and left their vessels to go on shore; while others prostrated themselves and besought Providence to protect them from the approach of the horrible monster which was marching on the tides, and lighting its path by the fires which it vomited." Such a description is worthy of Maundeville. In September 1807 the "Clermont" was running as a regular packet between New York and Albany, the time allowed each way being 36 hours.

Only a few days after this very successful trial trip, the "Phœnix" ran the same course in less time than the "Clermont," under the care of Robert Stevens, but Fulton's monopoly prevented any advantage being derived from it; she was consequently placed as a packet on the line between New York and New Brunswick, but not turning out a commercial success, in the middle of 1808 it was decided to send her by sea to Philadelphia.

The passage was made in a gale of wind in three days, including a stoppage at Barnegat. This steamer was the first one fitted with feathering paddle wheels, and also the first one to perform an ocean voyage; she ran for many years on the Delaware between Philadelphia and Trenton.

The following table gives particulars of the steamboats actually constructed during the period just concluded:—

Designer.	Name of Boat.	Propeller.	Speed per Hour.	Date.
Jeuffrey	—	Paddle	—	1783
Miller	"Dalswinton"	Paddle	4 miles	1788
Miller	"Carron"	Paddle	7 „	1789
Fitch	—	Stern oars	7 „	1790
Fitch	—	Screw	—	1796
Symington	"Charlotte Dundas"	Paddle	6 miles	1801
Fulton	—	Paddle	4 „	1803
Trevithick	—	Paddle	7 „	1804
Stevens	—	Screw	—	1804
Stevens	—	Twin-screw	8 miles	1805
Fulton	"Clermont"	Paddle	5 „	1807
Stevens	"Phœnix"	Paddle	5 „	1807

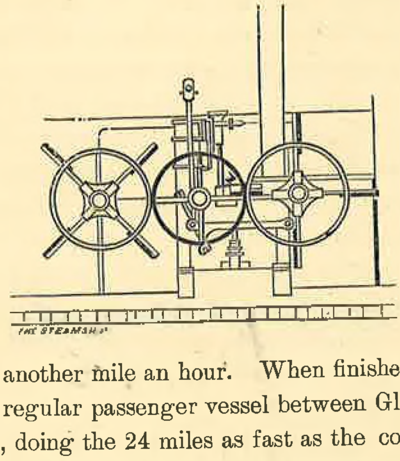
PERIOD III.

From the Performance of the First Ocean Voyage to the First Use of Compound Marine Engines.

THE practicability of ocean navigation, even in bad weather, having been demonstrated by the voyage of the "Phœnix" from New York to Philadelphia, a new impetus was given to the application of steam to successful commercial operations. Amongst those who had taken great interest in the trials of the "Charlotte Dundas" on the Forth and Clyde Canal, and who had kept up a correspondence with Fulton during his experiments on the rivers of France and America, was an illiterate but persevering Clyde millwright, Henry Bell of Helensburgh (estudió, proyectó y trabajó en la [illegible] de vapor desde 1799). A short time previous to the launching of Symington's canal tugboat, Bell had fitted a four-horse engine in a small vessel, and taken a trip from the Clyde to the Thames, realising a speed of seven miles an hour, and occasioning a chase from a sloop of war in the Bristol Channel. He applied for assistance or recognition from the Admiralty, but the well-known red-tapeism of naval administration rejected his applications, and Bell was forced to carry on his experiments on his own resources, which he appears to have done for several years. In 1811 Wood, of Port-

Glasgow, built the hull, and Robertson, of Glasgow, built the engines of the "Comet," a vessel of 25 tons designed by Bell. When first launched she was 42 ft. long, 11 ft. broad, and 5 ft. 6 in. deep, having a cylinder 11 in. diameter by 16 in. stroke, driving two pairs of paddle wheels of four floats each (see Fig. 9), and realised five miles an hour. To increase the speed she was lengthened to 60 ft., and 30 tons burthen, and one pair of paddles done away with, the result being that she made another mile an hour. When finished she was used as a regular passenger vessel between Glasgow and Greenock, doing the 24 miles as fast as the coaches, and at two-thirds the cost, but for the first six months Bell was a heavy loser, as but few people "wold venture their preshious lives in her," to use his own words, "but in course of the winter season she begun to gain creadit," as she was realised to be a safe and practical boat. It will be understood that Bell's share in the introduction of

Fig. 9.—Engines of the "Comet."



steam navigation was confined to the commercial aspect entirely, for directly the "Comet" was finished she was advertised as a passenger boat; but unfortunately for him, immediately he began to overcome prejudice and reap the benefit, rivals started into existence and deprived him of that reward to which he was certainly entitled for his persevering exertions and pecuniary losses. Amongst these rivals was one John Thompson, who had been a partner with Bell, but fancying he had not received sufficient credit for his share in the business, he had a vessel built on his own account by the builder of the "Comet," and obtained a speed of nine miles an hour, or half as fast again as she was. This vessel, the "Elizabeth," was 51 ft. long, 12 ft. broad, and 5 ft. deep. Thompson of course knew all the good points of Bell's engines, and the builder knew all the good points of his vessels, hence if they had not succeeded in constructing an improvement on his designs they would have been very poor tools indeed! Thompson has been compared to Fulton, who improved on Symington's designs, but it must not be forgotten that Fulton had experimented on his own account before ever he knew Symington, whereas Thompson had done nothing but assist Bell, hence there is no comparison between the two.

Bell built several boats subsequently, but was terribly unfortunate with them. The "Comet" was lost on the west coast of Scotland in Dec. 1820, and in Sept. 1821 another of his boats was destroyed by fire while lying at anchor, the two together meaning a loss of £3000 to him, as neither was insured. Among his many other

(pudo ser puesto a flote y no se hundió definitivamente hasta 1845) inventions may be noted machines for printing ladies' garments and for drying cloth by steam. Before his death, in 1830, he received a grant of £200 from the Government, and a pension of £200 from the Clyde Trustees, one-half of which was continued to his widow.

In 1815 Ralph Dodd, in emulation of Bell's voyage of 1800 from the Clyde to the Thames, became possessed of the "Majestic," of 75 tons, had her fitted out with an engine of 14 horse-power, and sailed from Glasgow to London, calling at Dublin and Milford by the way, accomplishing the passage in an hour or two over five days. This voyage like that of the "Phœnix" from New York to Philadelphia seven years earlier, was a particularly stormy one, and thus the practicability of ocean navigation in bad weather was again demonstrated. When Dodd left the Clyde there were five steamboats in the passenger service in Scotland, and none in England, but his success was such that two years later he had succeeded in establishing seven steamboats on the Thames alone.

Previous to 1818 but little was done in Great Britain in taking advantage of these early successful applications of steam to navigation, but in America they were considerably more "go-ahead." "As early as 1813," says Thurston, "there were two shops at Pittsburgh building steam engines, and steamboat-building now became an important and lucrative business in the West." Contemporaneously with Bell's "Comet" at Glasgow was Roosevelt's "New Orleans" at Pittsburgh, a vessel of 200 tons, 138 ft. long, 30 ft. beam, and a speed of ten miles an hour. This boat probably performed the first voyage of any considerable length ever attempted, being continuously under steam for a fortnight when running from Natchez to New Orleans. Contemporaneously with Dodd's introduction of steam river navigation on the Thames was Captain Shreve's introduction of steam river navigation in the Mississippi valley. Fulton (who was of Irish parentage) had been a worthy disciple of Smeaton; Smeaton had brought the proportions of beam engines to as near perfection as could be done with the engines of his day; Fulton worked away at the designs of paddle engines, and brought them to as near perfection as was possible with their class. He invented the outer wheel bearing for the shaft, the paddle box to cover and protect the wheel, and proportioned the sizes and strengths of the engines to the work each part had to do, and thus inaugurated a system of design which resulted in the engine and boat forming a successful combination. Fulton, however, had stuck to the vertical engine; Shreve, in 1816, placed his cylinders horizontally, and coupled them direct to the paddle shaft, thus following the lead of Symington; he also used high-pressure steam and considerable expansion. The practical result of his improvements was that the voyage from New Orleans to Louisville was performed in less than half the time formerly occupied.

Before leaving the land of Fulton and Stevens to return once more to the progress made in England, it is only right that their efforts to introduce steam propulsion into the American Navy should be noticed. In

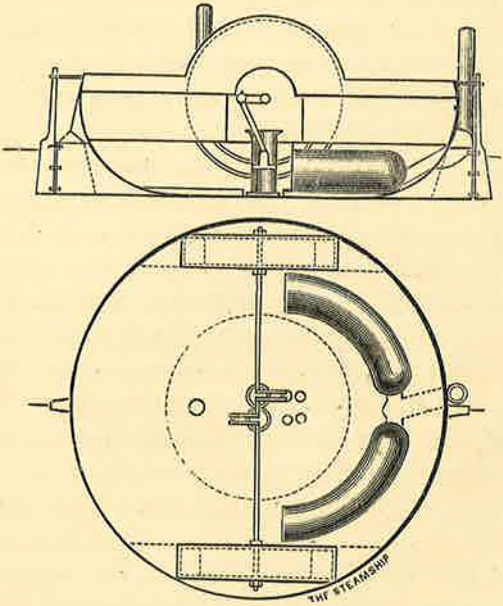
1812, during the American war, Fulton submitted the plans of the first steam man-of-war to a commission of American naval commanders, and being favourably considered the construction was authorised by Congress. She was built in 1814 in about four months, and launched at the end of October of that year, the trial trip taking place nine months later, when a speed of over 6¼ miles per hour was realised, and when quite completed and ready for sea with all stores aboard, the average speed was 5½ miles per hour. She was called the "Fulton the First," in honour of her designer, and was an enormous vessel, the hull being double, and of 2475 tons measurement, her length being 156 ft., breadth 56 ft., and depth 20 ft.; she was fitted with a single engine 48 in. diameter by 5 ft. stroke, a boiler 22 ft. long, 12 ft. wide, and 8 ft. high, and a single wheel 16 ft. diameter placed between the two hulls, a space of 15 ft. separating them for that purpose. She was a completely formidable and a highly creditable production, but Fulton died six months before she was completed; yet, although he did not live to reap any honours for his efforts, his name has never been forgotten in America, where he is always alluded to as the pioneer of successful steam navigation.

Thurston and Smiles both declaim against Fulton being classed as an actual inventor, although they allow that he was successful in introducing the inventions of others. But with all due respect to such authorities, if the inventions of others failed when tried by the inventors themselves, and yet when tried by Fulton they were successful, he must have been an improver and therefore an inventor to have been successful; he could see where others had failed, and knew what their failures were due to, and put the finishing touch on the inventions which produced the successful result. As Knight says, much unnecessary acrimony has been shown in Great Britain in reference to the claims of Fulton, because he was manifestly practical and successful, and an *American.* We have the same thing occurring at the present time on our railways over the respective merits of a well-known unreliable English brake and a well-known perfectly reliable American brake.

At the same time that Fulton was occupied with the designs of his man-of-war, Colonel Stevens was upon the design of a saucer-shaped ironclad, to carry a heavy battery at anchor, and provided with screw-propellers to swivel her rapidly, thus keeping up a continuous fire from her guns, each of which would be cleaned and loaded during the interval of discharging and coming round to be fired again. The design of hull was almost precisely similar to Trevithick's of 1808, only he cut the sides away for paddle wheels instead of using screws, and fitted her with rudders for manœuvring purposes. (See Fig. 10).

The next most interesting point in the application of steam to navigation was the first attempt made to cross the Western Ocean by that means. The older sailing packets performed the journey, out and home, across the Atlantic in an average of 57 days, and the later sailing ships, the "Liners," reduced the time to 50 days. The question having sprung up in 1818 as to the ability of a steamer to perform the voyage, Mr Scarborough, of Savannah, bought a vessel of 350 tons to try the experiment. At the time of purchasing she was still on the stocks at Crocker & Fickett's, Corlears Hook, New York, and he was therefore able, with the aid of Captain Rogers, who had been familiar with the experimental craft of Fulton and Stevens, to have her fitted out according to his own ideas and designs, the engines being built at Elizabeth Town, New Jersey. On being launched she was named the "Savannah." She left

FIG. 10.—TREVITHICK'S SAUCER-SHAPED IRON STEAMSHIP.



+ En memoria y honor del primer viaje trasatlántico efectuado por un vapor, cual lo era el "Savannah„, se celebra todos los años, el 22 de mayo, en los Estados Unidos el llamado "National Maritime Day„.

New York on April 27th, 1819, for Savannah, where she arrived May 4th, leaving again on the 26th of the same month, and reaching Liverpool June 20th, being under steam 18 days, performing five miles an hour, and under sail eight days, performing three miles an hour. From there she proceeded to St. Petersburg, calling at Copenhagen and Stockholm, and returning by way of Cronstadt and Arendal, reaching Savannah again in 25 days, or a total of 50 days from St. Petersburg. The "Savannah" had a single engine, 40 in. diameter by 6 ft. stroke, driving a pair of side wheels, of which the floats were capable of being unshipped and hoisted on board when requisite. On her return to New York her machinery was taken out, and she was used as a sailing ship for three or four years, being eventually lost. Another steamboat was built at New York the year after the "Savannah," of the same class, for trading down the coast, and proved a splendid ocean-going boat. In 1825 the "Enterprise" (Captain Johnson) made a voyage from New York to India, doubling the Cape of Good Hope in 47 days. In 1829 the "Curacoa" was trading between Holland and the West Indies, partly sailing and partly steaming, but there is no record of her passages to refer to for information.

The compound engine was first patented by Hornblower in 1781, and the idea was developed by Trevithick and Woolf with the use of high-pressure steam. The first engine of this class was erected in 1804, and in 1813 the idea was applied to the Cornish mine engines, but it was found that high-pressure steam with considerable expansion in one cylinder gave quite as good results. Wright in 1816 took out a patent for a form of compound marine engine in which the cylinders were of about the same size, working at a pressure of 40 lbs., but there is no evidence that his designs were ever carried out.

The first use of compound engines for marine purposes in America was in 1825. "In that year," says Thurston, "James P. Allaire, of New York, built compound engines for the 'Henry Eckford,' and subsequently constructed similar engines for several other steamers, one of which, the 'Sun,' made the trip from New York to Albany in 12 hours 18 minutes; he used steam at 100 lbs. pressure." The proportions borne by the areas of the cylinders at that time appear to have been about as 6 to 7, a rule followed many years later when working at half the pressure.

Between 1826 and 1830 compound engines with 70 lbs. pressure were introduced on the Rhine and Meuse, the most notable examples being the Netherlands Steamboat Company's "Hercules" in 1828, and "Stad Keulen" in 1829. In the "Hercules" the two high-pressure cylinders were placed horizontally on deck, and the single low-pressure cylinder vertically in the hold, the shaft being driven by gearing, the side wheels being fitted with stepped floats. The high-pressure cylinders were 25 in. diameter, with a stroke of 5 ft, and the low-pressure 54 in. diameter, with a stroke of 3 ft. 6 in. She was evidently compounded in a hurry, as neither of her cylinders belonged to her, the small ones coming out of the " Agrippina " and the large one out of the " Atlas."

The "Clermont" in 1807 started the American shipbuilding yards, which were in full swing by 1813, and the "Comet" in 1812 started the British shipbuilding yards, which were in full swing by 1818, chief amongst them being the Woods, of Port-Glasgow ; and amongst the Clyde marine engineering establishments stands pre-eminent the name of Napier, a name that since 1818 has always been in the van of progress, not only in the introduction of improvements in marine engines, but also in the introduction of compound and triple engines later on.

The most decided advance at that time was the building of the "James Watt" in 1822 by the Woods, a vessel of 448 tons, and engines of 50 horse-power by Boulton and Watt, a speed of ten miles an hour being maintained. She was running between London and Leith for a while, and then sold to the Netherlands Company, who re-christened her the " Stad Keulen," and compounded her in 1829.

The following table gives a list of the chief boats built during the period just concluded :—

~ Se vislumbró ya el uso del hierro forjado en el campo de las aplicaciones marítimas o de la navegación en 1787, cuando una embarcación, para ser utilizada en un canal, fué construida por John Wilkinson. En 1822 apareció la pequeña embarcación con una rueda a popa "Aaron Manby", que fué el primer vapor de hierro (wrought iron, hierro forjado). En 1835 Fairbairn abrió sus astilleros en Millwall, con el fin de desarrollar las construcciones en hierro, y en el mismo año del ~~coronación~~ advenimiento de la reina Victoria,[38] en 1837, se obtuvo la clasificación del vapor "Sirius", que no era el Atlantic pioneer del mismo nombre y año. ("The Syren and Shipping", 16 septre. 1942, p. 381)

~ Un grabado del primer vapor con casco de hierro

Builder or Designer.	Name.	Date.	Nationality.
Fulton	Raritan	1808	American
Do.	Car of Neptune	,,	do.
Do.	Paragon	1811	do.
Bell	Comet	1812	British
Stevens	Philadelphia	1813	American
Fulton	Comet	1814	do.
Do.	Vesuvius	,,	do.
Dodd	Richmond	1815	British
Do.	Majestic	,,	do.
Do.	Thames	,,	do.
—	Caledonia	1817	do.
Crocker	Savannah	1818	American
Stevens	Passaic	,,	do.
Wood	Robert Bruce	,,	British
—	Superb	1819	do.
—	Eclipse	1820	do.
Stevens	Hoboken	1822	American
Wood	James Watt	,,	British
Stevens	Trenton	1824	American
Thurston	Babcock	,,	do.
Allaire	Henry Eckford	1825	do.
—	Hercules	1826	Belgic
Stevens	North America	1827	American
Cockerill	Atlas	,,	Belgic
Stevens	New Philadelphia	1828	American
Thurston	Rushlight	,,	do.
Stevens	Albany	1830	do.

Vide: Aaron Manby – "Aaron Manby" – 1822 – British, nota página 50.

~ History of the screw propeller: breve nota sobre la que ha publicado el jefe-maquinista de la Armada del Brasil señor R. de Farias Mello, en "Shipbuilding and Shipping Record,, – nº 14 enero 1937, pág. 31.

~ En 1937 se conmemoró en la Gran Bretaña el primer centenario del paso decisivo que para el desarrollo e importancia de los maquinistas navales se dió cuando en 1837 fueron elevados de su posición civil al rango de warrant officers, dándoseles a la vez una representación en Whitehall. A causa de haber sido colocados bajo la dirección del Admiralty los Post Office steam packets, casi se dobló entonces el número de vapores en la Navy List, y en 8 de agosto de 1837 fué botada al agua en Pembroke la primera fragata a vapor, la "Gorgon,,. El buque a vapor apareció por primera vez en la Navy List en diciembre de 1827, cuando se incluyeron los nombres del "Echo,,, "Lightning,, y "Meteor,,: en diciembre de 1836 figuraban 29 barcos a vapor, contándose entre ellos los primitivos barcos de guerra ingleses con propulsión a vapor: "Rhadamanthus,,, "Dee,,, "Phoenix,,, "Salamander,, y "Medea,,; el último de los cuales prestó tan excelentes servicios en el Mediterráneo al año siguiente, en 1837. Varios otros vapores estaban dedicados al transporte del correo desde Falmouth a Malta, Alejandría y otras partes. Los buenos resultados obtenidos decidieron al Almirantazgo a encomendarles el servicio de correos a través del Canal de la Mancha

"Changing from Sail to Steam,, – Naval Engineering 100 Years ago,, – "The Times,, 6 enero 1937)

PERIOD IV

From the First Use of Compound Marine Engines to the Introduction of the Screw-Propeller.

THE success attending the use of steam for the purposes of navigation decided the English Government in 1830 to employ it as the means of conveying the Mediterranean mails, and accordingly in February of that year the mail steamship service from Falmouth to Corfu was instituted, the vessels used being the "Messenger" of 200 horse-power and 730 tons, the "Flamer" of 120 horse-power and 500 tons, and the "Columbia" of 120 horse-power and 360 tons. It was on the performances of these vessels that Dr Lardner based his assumptions that no steam vessel could carry more than sufficient coal to enable her to make a voyage of two thousand miles, and that therefore it would be impossible for any steamer to make the voyage to America.

The calculations of Dr Lardner ran as follows:—The Admiralty steamers averaged 7¼ miles per hour, the distance covered thus being 174 miles per day, assuming there were no stoppages; but as in long voyages steamers could rarely work without interruption, due to stress of weather and derangements of the machinery, especially

~ En el nº de 10 diciembre 1942 de la revista "Shipbuilding & Shipping Record,,, pág. 567, hay un artículo ilustrado de Frank C. Bowen, titulado: "Paddle Warships a Century Ago,,. Consta en él que después de las pruebas entre el buque de hélice "Niger,, y el vapor de palas "Basilisk,,, hacia 1850, el Almirantazgo se decidió por la hélice, dejando las ruedas sólo para yates, buques hidrográficos y de vigilancia y cañoneros de poco calado.

~ La goleta "Santa Teresa,, fué el primer buque de hélice que tuvo la Marina española – 1858 (comprobarlo). ~

the paddles, it would be more correct to allow only 130 miles per day, with an average working time of 22 hours, the other two hours being allowed for casual stoppages. The consumption on the Mediterranean packets was at the rate of 2 cwt. per day per horse-power, and the bunker capacity was 1¼ tons per horse-power; thus they could steam 12½ days without refilling the bunkers, which at 160 miles per day meant a distance of 2000 miles. As a larger steamer meant more horse-power in proportion, the total fuel carried per horse-power would remain the same, and hence the distance covered could not be increased.

It was as late as April 1837 that these opinions were placed before the public, although both the "Savannah" in 1819 and the "Royal William" in 1833 had crossed from America—the former from Savannah, and the latter from Nova Scotia—but in neither case had steam been the entire propelling power, the sails being freely used. Only one year later, however, the calculation was shown to be an entire mistake, the voyage being accomplished by two English paddle-steamers—the "Sirius" of 700 tons and 250 horse-power, built by Menzies of Leith, and engined by Wingate of Glasgow, and the "Great Western" of 1321 tons and 450 horse-power, built by Paterson of Bristol, and engined by Maudslay of London. The "Sirius" left Cork on April 4th, 1838, and the "Great Western" left Bristol on April 8th, the former arriving at New York on the morning of April 23rd, and the latter on the afternoon of the same day. The coal consumption of the "Great Western" was 452 tons, or an average of thirty tons a day ; on later voyages this was reduced to twenty-seven tons. On her first voyage she carried seven passengers, but within two years she had become so popular that she never carried less than one hundred and fifty ; her total accommodation, including crew, was three hundred and ten. She was a tasteful and elegant ship for the time, her main saloon being 75 ft. long, 21 ft. broad, and 9 ft. high, the decorations being similar to the London clubhouses in luxury and magnificence. The "Liverpool" made her first voyage from Liverpool to New York in the same year. The successful results attained by the "Sirius" and "Great Western" inaugurated the Western Ocean steam-packet service, and since that time the trade has grown to enormous proportions without a break. The following table gives particulars of three of the earlier Transatlantic steamers :—

	Great Western.	British Queen.	President.
Built	1837	1838	1839
Cost	—	£100,000	—
Length	236 ft.	275 ft.	265 ft.
Breadth	35 ft. 4 in.	40 ft.	41 ft.
Depth	23 ft. 2 in.	27 ft. 6 in.	23 ft. 6 in.
Tonnage	1321	2016	1840
Horse-power	450	500	540
Diameter of Cylinders	73 in.	77½ in.	80 in.
Stroke	7 ft.	7 ft.	7 ft. 6 in.
Diameter of Wheels	28 ft. 9 in.	30 ft. 6 in.	31 ft.
Weight of Machinery	480 tons	500 tons	500 tons
Weight of Coal	600 tons	750 tons	750 tons
Weight of Cargo	250 tons	500 tons	750 tons
Draft of Water	16 ft. 8 in.	16 ft. 7 in.	17 ft.

Steam becoming a trustworthy agent, full-rigged steamships became uncommon, the barque-rig being substituted; the "British Queen" was an early notable example of this.

The performances of the "Sirius" and "Great Western" caused some of the newspapers of the time to go into heroics, as the following specimen, cut from one of large circulation, shows:—"Where is the Englishman who does not rejoice at the successive proofs which America continually gives that she remembers and does honour to her origin? And where is the American who does not look to England as the land of his fathers, whose heart does not glow at the remembrance of her glories, or who would not tread her shores with a feeling of reverence that no other scenes could call up? Was it only the excitement of curiosity that, when the 'Sirius' and 'Great Western' entered the harbour of New York, drew the whole population of the city forth to greet them with such heart-stirring acclamations? Would the same enthusiasm have marked the accomplishment of the experiment if it had been made under any other flag than that to which their fathers bore a willing allegiance?"

In 1824 the cross-channel service between England and Ireland was first carried on by the steamers "Mersey" and "Liffey," belonging to the City of Dublin Company, and fourteen years later they possessed twenty-one first-class steamers of 5550 aggregate horse-power. In 1835 the total number of vessels belonging to the United Kingdom was six hundred, four-fifths being river steamers and small coasters, with an average tonnage of less than 200, and an average horse-power of less than 90, the remaining fifth being large coasters and sea-going steamers, with a tonnage as high as 800, and a horse-power up to 300. Of this total, a third belonged to London, a tenth to the North-Eastern ports, and a seventh to the Mersey. In the same year the total number of steamers in America was eight hundred, and in France only 140. Thus the country where steam navigation was introduced, where the first successful paddle-steamer was built, and where Fulton carried on his experiments for several years, was only just awakening to the importance to be derived from the possession of vessels propelled by steam. In this she was far behind Belgium, a much smaller country.

The last sailing ferry-boat on the Thames was the "Duke of York" in 1834; steamers had then been in constant use for twenty years, and had gradually driven the sailing craft off the river. According to the evidence of Strachey, of the India House, in 1831, a model steamer ran from Westminster Bridge to Blackfriar's Bridge in 1793, but it appears to be doubtful whether his evidence can be depended upon. The Richmond and Margate paddle-steamers were established by Dodd in 1815; on the 23rd of January in that year, the "Margery" of 70 tons and 14 horse-power, commenced to ply as a ferry; she was soon followed by several others, the earlier ones being the "Thames" in 1816, and the "Sons of Commerce" in 1817. Ten years later a substantial improvement in size and power was inaugurated by the "Sophia Jane," a vessel of 50 horse-power, she being followed in 1829 by the "Kent," "Pearl," and "Essex." The first marine engine built by Maudslay was one of 10 horse-power for the "Richmond" in 1815 or 1816; the "Caledonia" in 1817 was fitted with beam engines by Boulton and Watt, she being the first one of her class. In 1819 the "Tug" ran on the Forth, and was used for towing purposes; in 1825 the first two steamers ran from Leith to London, one of them being the "James Watt" already mentioned. In the same year the first steamer left the Thames for the Rhine, but broke her shaft at Ruhrort, and was delayed there three weeks for a new one. In 1830 St Katherine's Wharf was opened, and the "Harlequin" made an excursion to the Nore and back with 400 passengers on board, the very first excursion on record. In 1834 Gravesend Town Pier was opened, and the "Star" landed 500 passengers. In the following year the "Ruby" of 272 tons was built by Lang of Woolwich, and engines of 100 horse-power put into her by Seaward, she being the fastest wooden boat on the river. To compete with her the "Rainbow" was built of iron by Ditchburn, and engined by Miller & Ravenhill, and subsequently took the palm from the "Ruby." From 1840 to 1843 there were nineteen vessels running.

As the size of engines increased, the wear of the valve-gear, due to its great weight, became a serious matter in a long run, so much so, that on arrival in port, it was often a difficult matter to manœuvre the engines sufficiently rapidly. To overcome the difficulty, Seaward invented his well-known valves; he also introduced direct-acting engines, which called down upon him a storm of abuse and ridicule, but the "Cyclops" and "Gorgon" paddle-wheel frigates were fitted with them in 1838 or 1839, and were quite a success.

Trevithick's connection with the marine steam engine may be summed up in the words of his son:—"During twelve years he had at various times shown the practicability of steam propulsion; in 1804 with a seven-miles-an-hour steamer; in 1806 the single-paddle steam-yacht; in 1808 the patent for universal steam on board ships; in 1812 the proposing to the Admiralty the use of the screw-propeller; in May, 1815, a screw 8 ft. 10 in. in diameter had been made, and in June, 1815, a patent for the screw was applied for; and when on the verge of success, he, in 1816, sailed away to the mountains of an unknown land." Tradition asserts that the "Civetta," a screw-steamer, was built at Trieste in 1829 by a native of the place, but, if it really was built, nothing ever came of it. Woodcroft experimented in 1832 with twin-screws on the Irwell, and realised four miles an hour.

* — Vide nota en "S.&S.R." del 11 febrero 1937, p. 185, acerca de la exposición celebrada en el Science Museum, de South Kensington, a propósito del 1º centenario del propulsor de Smith (febrero 1837).

The two men who brought the screw-propeller into successful use were Ericsson, the Swedish engineer, and Smith, the Kentish farmer. Ericsson's was a most peculiar propeller; two screws were used revolving in opposite directions, one abaft the other, the after one being keyed to the main shaft, and the former one being keyed to a hollow shaft working as a collar on the main shaft, and driven by gearing. (See Fig. 11). This propeller was fitted into a little steamer of only three feet draught, and drove her at ten miles an hour on the

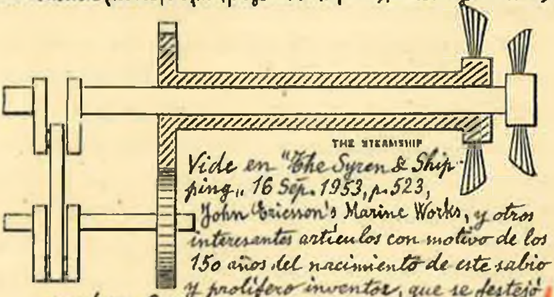
Véase en el nº de la revista "Shipbuilding and Shipping Record" de 13 agosto de 1936, pág. 201, el artículo: A Propeller Centenary Year. The inventions of Francis Pettit Smith and John Ericsson. Id., 11 febrero 1937, p. 185. ~ A. J. Couzens, de la firma J. Stone & Co. Ltd., sostiene que el verdadero inventor del propulsor de hélice fué John Swan, en 1824: "S.&S. Record", 20 agosto 1936, 217. Puede también leerse lo que del francés Sauvage dice G. Contesse en su libro "La Marine d'aujourd'hui", p. 174 y sigtes. ~ ~ J. E. Flack, [illegible] de la "Bull's Metal & Melloid Co." dice que la 1ª patente para instalar un propulsor de hélice en los barcos se otorgó a José Bramah en 9 mayo 1785, y la 1ª instalación hízola Wm. Lyttleton en 1794: vide "S.&S. Record", 3 Sep. 1936, p. 269.

~ Facsímil de los certificados de las pruebas realizadas con un propeller, y expedidos en Gibraltar, el 4 de Julio de 1802, y en Malta, en 2 y 4 de Septiembre de 1802: "Shipbuilding & Shipping Record", 24-XII-1936, pág. 767.

Thames, and afterwards, when she was used as a tug-boat, easily towed large vessels at five miles an hour. Representatives of the Admiralty took a trip in the boat, but the red-tapeism which prevented Bell from succeeding with them, also barred the progress of Ericsson in the matter. The American Consul at Liverpool at that time was, like all natives of his country, cute enough to see the value of the invention, and with his help and that of Captain Stockton of the American Navy, another and larger boat was built of iron and named the "Stockton;" she was taken across the Western Ocean, sold to the Delaware Canal Company, re-christened the "New Jersey," and ran with success for several years.

FIG. 11.—ERICSSON'S PROPELLER.

(Juan Ericsson (hélice, buques, proyectiles-torpedos), n. 1803 y m. 1889)



Vide en "The Syren & Shipping", 16 Sep. 1953, p. 523, John Ericsson's Marine Works, y otros interesantes artículos con motivo de los 150 años del nacimiento de este sabio y prolífero inventor, que se festejó mucho en Suecia.

Smith's boat, the "Archimedes," of 237 tons, was built in 1838 on the Thames; she was the first successful British screw-steamer of large dimensions. On her trial she realised a speed of 9 knots an hour. She was 155 ft. long, 22 ft. beam, and 10 ft. draught, driven by engines of 90 horse-power. She was tested between Dover and

~ El primer vapor francés de hélice fué el "Napoleón", botado el 6 de diciembre de 1842. En 1842 se puso también la quilla del primer buque de guerra a hélice, el "Princeton"; pero no estuvo listo hasta 1844: debióse al capitán Roberto Stockton, de la Armada de los Estados Unidos; el cual fué instruido sobre este punto por John Ericsson, desde 1841. – Véase un artículo acerca del propulsor de hélice en "The Syren and Shipping", nº 23 diciembre de 1942, pág. 319.

Calais with the mail paddles there by order of the Admiralty, with very successful results, and subsequently traded round the coast. The "Rattler," a Government vessel of 800 tons and 200 horse-power, was fitted with a screw-propeller in 1842, and the "Alecto," also a Government vessel, built on the same lines and of the same power, was fitted with paddles, and a series of experiments carried out to compare the two methods of propulsion, the screw scoring first place, realising a mean speed of 9·2 knots per hour, whereas the paddle's mean speed was only 8·8 knots.

The largest vessel built at that time was the "Great Britain," launched in 1843. She was constructed of iron, 322 ft. long, 48 ft. 2 in. beam, 31 ft. 5 in. deep, with a draft of 16 ft., and a gross tonnage of 3270. She had geared engines, at first driven by a chain, but she stranded in Dundrum Bay on the coast of Ireland, and remained there several weeks; on being finally got off she was fitted with oscillating geared engines by Messrs. Penn, the two cylinders being $82\frac{1}{2}$ in. diameter by 6 ft. stroke, and 500 nominal horse-power. The screw was 15 ft. 6 in. diameter and 19 ft. pitch, the gearing being at the rate of three to one, eight cog-wheels being used. She made several voyages to America, and was afterwards used in the Australian trade. She was designed by Brunel and Paterson (the architect of the "Great Western"), and fitted with Smith's Archimedean screw. Her highest speed was $13\frac{2}{3}$ knots an hour, the maximum revolutions of the engines being 16, and her average speed in a gale was

~ Puede verse la historia del "Great Britain" en el libro "The Blue Riband" y con mucha mayor extensión en un artículo especial del número extraordinario de verano – 1943 de la revista "The Syren and Shipping" – 30 junio 1943, pág. 370.

8½ knots with 13½ revolutions of the engines. On her trial trip from Kingroad, in the Bristol Channel, to the Downs, she accomplished the distance of 320 knots in 29 hours, and far out-distanced all other steamers which she happened to fall in with, one notable example being the Hull packet, which she beat one hour and twelve minutes in a run of 33½ miles.

This period of the History of Steam Navigation is noted for the introduction of the surface-condenser by Samuel Hall in the "Windermere" in June 1835, the "Hercules" in 1836, and the "Wilberforce" in 1837, but as he was unable to keep the tubes tight, his plan was a failure. To overcome the nuisance the indiarubber sheet method of packing was brought out, but the modern surface-condenser is fitted with screwed glands exactly the same as Hall used them.

PERIOD V.

From the Introduction of the Screw-Propeller to the Launch of the Leviathan.

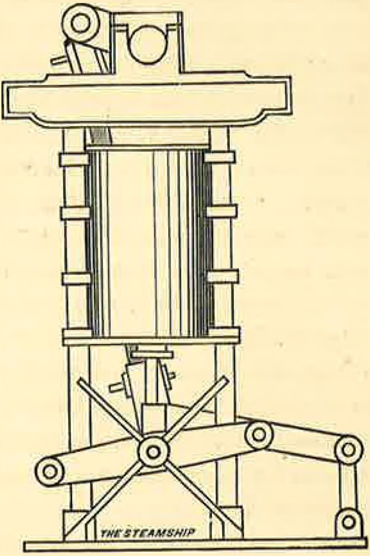
ALTHOUGH the screw-propeller had been shown to possess considerable advantages compared with the paddle-wheel, a long period was allowed to elapse before it was looked upon with any degree of favour. Engineers had become accustomed to constructing heavy engines to run at the slow speeds that were necessary when driving paddles, and such engines were accordingly used to drive screws, but as the screw had to run three to four times faster than the paddle to be an efficient propeller, it required the introduction of gearing. This, together with the extra length of tunnel shafting, made the engines more expensive to build, and there was no reduction in the working expenses to balance it. Again, although it was well known that the huge paddle-boxes held the wind to a great extent, that when starting on a voyage the wheels were often too deeply immersed and at the end of the voyage they were not immersed enough, and that the wheels and boxes were always being damaged in bad weather, yet engineers preferred a visible wheel to an invisible screw. Gradually, however, its manifest suitability for steamship propulsion rendered its adoption a matter of necessity. What steamship owner could shut his eyes to the fact that a screw vessel could lie close alongside the quay, whereas a paddle vessel was nearly twice as far away; that the engineer's department of a screw vessel occupied but a comparatively small space, whereas the engines of a paddle vessel took up one-third of the length of the hull; and that direct-acting screw-engines could be built at less cost than the paddle-engines, and would consume less fuel when running? But the most suitable form of screw-engine was not evolved immediately; numerous arrangements were tried before a standard form came to be recognised as the best one to use; and it was even tried to box up the paddle-engine into a smaller space to compete with it. The changes made in the methods of driving marine engines make an interesting study. The old land beam-engine was not capable of being adapted to sea-service, so the beam was duplicated and placed low down, forming the side-lever engine. This was a very cumbrous form, and gave place to the double-cylinder engine of Maudslay, which did away with the side levers, but saved very little room. The next advance was the introduction of the oscillating engine by Penn, whereby the piston and connecting rods were joined into one. The first oscillating engine was fitted into the "Aaron Manby" in 1821, but it was not till 1837 that it was brought into general use by Penn. The first set of oscillators applied to a large sea-going steamer were the engines of the "Black Eagle" of 260 horse-power, built for the Admiralty. The oscillating engine was for a long

Una vista del mismo —única que se conserva— consta en el número de "Shipbuilding and Shipping Record" de 4-III-1954 (V pág. de anuncios). Dice que fuè el primer vapor con casco de hierro; que abundaban entonces (en 1822) los que aún creían que no flotaría y navegaría con èxito, pero que fracasaron en el pronóstico. La única preocupación o temor de su constructor Aaron Manby fuè el de la conservación de la carga y por esto colocò un forro de madera en las pequeñas bodegas de este buque, precursor de tantas y tan maravillosas naves.

time regarded with considerable distrust, the chief objection being the fear that the cylinder would wear oval; but experience proved that the side-lever engine actually wore more than the oscillating engine in this respect, and by fitting a deep stuffing-box, and having rather a larger piston rod than was absolutely necessary, it has been found that oscillating engines work well for years. Vertical direct-acting overhead-crank or Gorgon engines were tried by Boulton and Watt, Scott and Sinclair, Robert Napier, Seaward, Miller and Ravenhill, Rennie, and Fairbairn; steeple engines were brought out by Tod and Macgregor, and David Napier; double cross-head engines on the same principle as Maudslay's double-cylinder engines by Fawcett and Preston, and Bury; and Forrester in the "Helen MacGregor" inverted the cylinders, and made a return connecting rod Siamese engine, only the crank shaft was above the cylinder instead of below it. (See Fig. 12).

As the "Helen MacGregor" was rather a novelty, it would be a pity that the advantages claimed for her should sink into oblivion. The two cylinders were each 42 inches diameter by 4 feet 6 inches stroke, of 220 horse-power, the ratio of horse-power to tonnage being 1 to 2·6. There were two inverted cylinders standing on wrought-iron columns, bolted to the foundation plate, and supporting the entablature above. The cylinders were placed athwartships, the piston rods working below them and connected to one crosshead, the connecting rod transmitting the power from the crosshead below to the crank above, the parallel motion for guiding the piston rods being formed from the levers for working the pumps. The ends to be gained from the Siamese engine were:—Firstly, by having two cylinders instead of one, the difficulty of making large cylinders perfectly true was obviated, and the two pistons were stronger for the same weight than one of double the area; secondly, by having the piston rods working through the lower covers, the pistons were accessible by lifting the top covers without disconnecting any part of the engines; thirdly, the cylinders being high up prevented water running over into them from the boilers, as they were above the water line, and also prevented the water getting into them from

FIG. 12.—ENGINES OF THE "HELEN MACGREGOR."



the condenser, a difficulty sometimes experienced with other classes of engines; and fourthly, there was a great reduction in weight and space compared with ordinary engines, thus giving additional room for cargo. Many of these advantages are identical with those claimed for the modern vertical screw-engine.

But the paddle-wheel, as a propeller, was doomed for ocean voyages, and engine-builders had to adapt their engines to the new propelling instrument. Boulton and Watt laid the oscillating engine horizontally, Maudslay and Holm laid the steeple engine horizontally and produced the return connecting rod engine, Penn invented the trunk engine, Seaward and Rennie used direct-acting horizontal engines, Stothert direct-acting diagonal engines, Whitelaw beam engines, and Blyth oscillating engines driving the screw-shaft by a bell-crank arrangement; but it was reserved for Thomson to bring out the vertical inverted direct-acting screw-engine in the form that, by a species of survival of the fittest, is looked upon at the present day as the only suitable one. Other makers tried geared engines of various descriptions, the most notable being the oscillating geared engines fitted to the "Great Britain."

The Peninsular and Oriental Company was founded in 1837. Previous to the appearance of their vessels the mails had been carried by the Admiralty steamers, as mentioned in Period IV., from Falmouth to Corfu, the service being started in February 1830. In the same year a Bombay-built steamer, the "Hugh Lindsay," ran from Bombay to Suez and back, and this circumstance directed the attention of the Government to the possibility of carrying on a regular mail service with India, *via* Alexandria and Suez. In 1835 the Corfu mail service was extended to Alexandria, whence the mails were conveyed to Suez; the "Hugh Lindsay" then took them to Mocha, on the eastern shore of the Red Sea, near its mouth; and from Mocha they were carried to Bombay by the steamers "Atalanta" and "Berenice." On the founding of the Peninsular and Oriental Company the contract for the mail service was secured, and in 1840 the mail to Bombay was carried by them, being extended in 1843 to Calcutta, in 1845 to Ceylon, and in 1847 to China. One of the earliest of their steamers was the "Iberia," 156 ft. long, 24 ft. beam, 15 ft. 9 in. deep, 516 tons, 400 indicated horse-power, and speed 8 knots on a consumption of 21 tons per day.

One of the great epochs in the History of Steam Navigation was the founding of the Cunard Line. Samuel Cunard, a merchant of Halifax, Nova Scotia, and agent for the East India Company, had conceived the idea of starting a steam packet service between England and America in 1830, but his propositions met with no success. The voyages performed by the "Sirius" and "Great Western" in 1838 caused the English Government to issue circulars asking for tenders for the conveyance of the American mails by steam. Cunard came to London, but, failing to find sufficient interest, he proceeded to Glasgow, where he associated himself with the late Sir George Burns, Robert Napier, and David MacIver. Between them they raised a capital of

£270,000 to build four steamers, and obtained the mail contract for seven years, the inauguration of the American steam mail service taking place in July 1840 with a wooden paddle steamer. The Cunard Line started with four Clyde-built steamers—the "Britannia," built by Duncan; the "Acadia," built by J. Wood; the "Caledonia," built by C. Wood; and the "Columbia," built by Steel—all engined by Napier with common side-lever engines. They were 207 ft. long, 34 ft. 4 in. beam, and 22 ft. 6 in. deep; with cylinders 72 inches diameter by 6 ft. 10 in. stroke; paddle-wheels, 28 ft. diameter; nominal horse-power varying from 440 to 450; and tonnage ranging from 1139 to 1155. The "Britannia" ran 8½ knots an hour on a consumption of 38 tons a day. She left Liverpool with the first mails on her maiden voyage on July 4th, 1840, and arrived at Boston on July 18th, performing the voyage in 14 days 8 hours. In February 1844 she got ice-bound in Boston Harbour, necessitating a canal cutting through the ice 7 miles long by 100 feet wide.

The success of the Cunarders caused rival steamship companies to be quickly formed, the earlier ones being the Royal Mail (West Indian) in 1840, the Pacific Mail in 1843, the Collins (American-owned) in 1850, the Inman in 1850, the African Mail in 1851, and the Allan in 1854. The Allan Line had previously run sailing ships since 1823. The most noted of these was the American Collins Line. It consisted of five boats—the "Atlantic," "Adriatic," "Arctic," "Baltic," and "Pacific." The "Adriatic" had two cylinders, 101 in.

≈ El acero comenzó a usarse para algunos vapores de ruedas de gran velocidad en el año 1859. Acero dulce de buena calidad se produjo por primera vez hacia 1873: en dicho año se empleó en Francia para la construcción de barcos de guerra. Los procedimientos de Bessemer y de Siemens se usaron: el primero en 1863, pero muy imperfectamente, y hacia 1875 se avanzó mucho en la fabricación del acero Siemens. En este año se empleó el acero dulce en la construcción de los H.M.S. "Iris" y "Mercury", que fueron los primeros que se construyeron en la Gran Bretaña. (tomado de Practical Shipbuilding por A. Campbell Holms - 1916 - Longmans, Green & Co. - London)

diameter by 12 ft. stroke, working at a pressure of 26 lbs., which, cutting off at half-stroke, gave an indicated horse-power of 4800. Her wheels were 40 ft. diameter, with 32 floats, 12 ft. long by 3 ft. wide. The "Atlantic" was 276 ft. long, 45 ft. beam, 31 ft. 6 in. deep, and 2860 tons. The Collins Line was, however, very unfortunate, the "Arctic" being lost by collision, and the "Pacific" disappeared like the "President;" the "Atlantic" and "Baltic" were turned into sailing ships, the latter surviving till 1880, when she was broken up at Boston.

The leviathan steamer "Great Eastern" was the joint design of Brunel and Scott-Russell, and Scott-Russell's name will always be remembered in connection with the "Great Eastern" rather than anything else. He was born in the Vale of Clyde in 1808, graduated at Glasgow when sixteen years of age, at twenty-four he was elected to the Professorship of Natural Philosophy at Edinburgh, and then manager of a shipyard at Greenock, where he built the "Wave," the first vessel on his principle, in 1834. His researches on wave motion were communicated to the British Association in 1835, and a second paper on the subject in 1837 was read before the Royal Society of Edinburgh, for which he received a gold medal and was elected a member of the Council. He removed to London in 1845, and was elected a Fellow of the Society of Arts and M. Inst. C.E. in 1847. From 1856 to 1858 he was building the "Great Eastern," the largest vessel ever designed, although our modern Atlantic liners are fast approaching her in size, and will undoubtedly, ere many years, be even

~ El "Great Eastern", que al principio era conocido por el "Leviathan", se le colocó la quilla el 1º de mayo de 1854; fué lanzado al agua, después de varias dilaciones, el 31 de enero de 1858; comenzó las pruebas el 9 de septiembre de 1859, y zarpó de Southampton para su primer viaje a New York el 17 de junio de 1860. La reina Victoria y el príncipe consorte lo habían visitado el 28 d junio 1858

El "Great Eastern„ se proyectó para que realizara viajes entre Inglaterra y Calcutta o Colombo, en combinación con vapores y veleros que llevarían luego a los pasajeros y carga a sus respectivos destinos. ~ La proporción de eslora, manga y puntal del Arca de Noé se mantuvo sensiblemente igual por muchos siglos, nota en "S.&S.R.„ - 19 Dic. 1935, p. 682. ~ Algunos detalles acerca de la venta y desguace del "Great Eastern„ en el nº de 9 Enero 1936, pág. 34, de Ship-building and Shipping Record.

~ Sobre este barco-gigante y su lanzamiento en particular, artículo extenso en "S.&S.R.„, 29 Oct. 1936, pág. 515.

larger. The particulars of the "Great Eastern" were as follow :—

~ Véase una nota que sobre un modelo del "Great Eastern„ que se probó en 1885 en el tanque de Torquay, en comparación con otros de diversos y notables trasatlánticos, consta en el suplemento o notas ~~finales~~, pág. 9, de la obra de Attwood "Buques de guerra„. ~

Designers—Brunel and Scott-Russell.

Builder—Scott-Russell.

Material—Iron.

Speed—14½ knots. ●● ≈ Véase una tabla que hay en la pág. 29 del nº extraordinario de "The Shipbuilder„ dedicado al "Aquitania„ y una nota anexa manuscrita. ≈ ●●

Date—1858.

Gross tonnage—23,093 tons.

Length between perpendiculars—680 ft.

según el "Lloyd's Register Book„ de 1879-80: 18.915 g. tons, 679'6 × 82'8 × 31'6 ft. (built 1858) - screw & pad. Bk. - → 18.337 under deck y 13.344 net tons.

Breadth, extreme—83 ft.

Depth—58 ft. = 17'68

Draft, light—20 ft. = 6'10

Draft, laden—30 ft. = 9'14

En el mismo libro-registro de 1887-88 consta debajo del puntal de arqueo, otro de 48'2 ft.

Screw Engines :—N.H.P., 1000. (en artíc. Ship de "Ency. Brit.„ 1910, por Sir Philip Watts, pone: 4.886 H.P.) (Sir Philip Watts acepta el desplazamiento de 32.160 toneladas, que consta también en la tabla, tomada en parte, de la obra "The Atlantic Ferry„, por [illegible] A. J. Maginnis, y consigna 18.915 toneladas de registro bruto.)

Builders—Boulton and Watt.

Description—Horizontal direct-acting.

Cylinders—Number, 4.

Diameter—84 in. = [illegible] 2'133 mt.

Stroke—4 ft. = 1'219 mt.

Revolutions per minute—55.

Screw-propeller :—Number of blades, 4.

Diameter—24 ft. = 7'31

Pitch (paso)—44 ft. = 13'41

Paddle Engines :—N.H.P., 1000. (en idem., idem.: 3.411 H.P.) (en total, se indican más abajo(?), 11.000 H.P.)

Builder—Scott-Russell.

Description—Oscillating direct-acting.

Cylinders—Number, 4.

Diameter—74 in. = 1'879 mt.

Stroke—14 ft. = 4'27 mt.

(llevaba además 6.500 yardas^2 de superficie de velamen)

Paddle-Wheels :—Description—Radial. (ruedas de paletas fijas)

Diameter—56 ft. = 17'07

Length of floats—13 ft. = 3'96

Width of floats (paletas)—3 ft. = 914 milímetros

~ Algunos pormenores acerca de las vicisitudes del "Great Eastern„ y en particular sobre el gobierno del timón por medio del vapor, que no se adoptó hasta 1867 - artículo en el nº extraordinario de "The Syren and Shipping„ de 2 enero 1952, pág. 25. ~

~ En "The Syren & Shipping„ de 16 enero 1954, pág. 238, consta algún detalle sobre las planchas de hierro empleadas en el "Great Eastern„.

Boilers :—Number, 4 for the paddle engines, 6 for the screw engines.

Description—Tubular.

Pressure—25 lbs.

Paddle boilers :—Length—17 ft. 9 in. = 5'41 mt.
Breadth—17 ft. 6 in. = 5'33 mt.
Height—13 ft. 9 in. = 4'19 mt.
Screw Boilers :—Length—18 ft. 4¾ in. = 5'60 mt.
Breadth—17 ft. 6 in. = 5'33
Height—14 ft. = 4'27

Bunker capacity—10,000 tons.

The "Great Eastern" cost about a million of money to build, launch, and equip; she was used with some success in the service of the Telegraph Companies, and was eventually sold in 1885 for £26,200.

According to the letters of Miss Sedgwick, in August 1841 Charles Babbage, the gentleman of calculating celebrity, prophesied that iron ships would supersede all others, and that iron steamers would cross the Western Ocean within seven days. Twenty years later iron ships did supersede all others, but it was forty years before the second part of the prophecy came true.

The first iron steamer actually built was the "Aaron Manby" in 1821, but iron steamships had been proposed by Trevithick as far back as 1808. In 1850 the Inman Line started with iron screw-steamers, as also the Allan Line in 1854. In 1855 Robert Napier built the "Persia," the first iron Cunarder, but she was a paddle; it was not till 1861 that the Cunard Line adopted iron screw-steamers, the first one being the "Russia," built by the Thomsons.

EL CENTENARIO DEL «GREAT EASTERN»

NINGUN suceso marítimo más sensacional y discutido en los comienzos de la segunda mitad del siglo XIX que la construcción del «Leviathan» o «Great Eastern», proyectado por el ingeniero inglés I. K. Brunel, hijo de un antiguo oficial de la Real Marina francesa expatriado por la Revolución. Se trataba de un navío seis veces mayor que los de más porte conocidos, superioridad que conservaría más de cincuenta años. Una mañana de finales del año 1857, ambas orillas del Támesis — cuenta Van Loon en su «Historia de la Navegación» — rebosaban de curiosos aguardando el lanzamiento del imponente casco, que no llegó a penetrar en el agua, y entre el hostil clamoreo del público, quedó inmovilizado en grada más de dos meses. Quebró la Compañía constituída por Brunel y éste falleció una semana antes de que el buque saliera del Támesis. Adquirido por nueva empresa, sustituyó su nombre de «Leviathan» por el de «Great Eastern», bajo el cual continuó su accidentada carrera de constantes desventuras con el común denominador de los descalabros financieros padecidos por los sucesivos armadores que pretendieron explotarlo comercialmente. Sólo doce travesías llegó a realizar en la línea Europa - América durante los treinta años de su precaria vida y en ningún viaje completó ni mucho menos la cabida de sus camarotes — un millar de pasajeros — y bodegas. Una varada en la costa de Irlanda lo tuvo casi un año inmóvil y sus Diarios de Navegación registraron demasiados percances y averías. Pero lo ensalzó Víctor Hugo — «no lejano país para tus pies»... —, Julio Verne le dedicó una novela, «La Ciudad Flotante», que ha tenido millones de lectores, y no han escaseado libros y folletos descriptivos del famoso «Great Eastern» y su historial. Donde resultó eficaz fué en el tendido del cable submarino trasoceánico de la «Atlantic Telegraph» en 1866, que sin su cooperación no hubiera sido factible. Antes y después de tan honrosa comisión, el «Great Eastern» circuló de mano en mano de negociantes que especularon con la fama del navío, que una vez hasta se intentó venderlo a la Armada española, y en otra ocasión se compró para destinarlo a depósito flotante de carbones en la bahía de Gibraltar. Al fin, en 1888, sus últimos dueños, que lo adquirieron en subasta por 16.500 libras esterlinas, lo desguazaron en Inglaterra.

Extraña traza la del célebre «Great Eastern» con sus ruedas laterales de paletas, seis palos con vergas para un supletorio aparejo velero y cinco chimeneas. Para su propulsión, además de las ruedas, tenía una hélice. Sus características principales eran cerca de 19.000 toneladas de arqueo y 28.500 de desplazamiento, 210 metros de eslora por 25'3 de manga, 18 de puntal y 7'6 de calado, 14.100 caballos de fuerza en las cuatro máquinas motrices de las ruedas y 1.700 las de la hélice, velocidad máxima de quince nudos. «No ha costado menos de veinticinco millones de francos», escribía asombrado L. Renard en sus «Merveilles de l'Art Navale». Y, sin embargo, tal cantidad parece hoy irrisoria al compararla con el coste de «veintisiete mil millones de francos» presupuesto para el trasatlántico «France», de 55.000 toneladas, el más caro que se haya construído hasta la fecha. En cuanto a dimensiones, las del «Great Eastern» hoy las mide cualquier mediano buque trasoceánico de pasaje, de modesto porte al lado de los «Queen Elizabeth» y «Queen Mary», con sus 80.000 toneladas y 300 metros de eslora, a su vez superados por los novísimos petroleros gigantes y quizá, en un porvenir no demasiado lejano, por las presentidas naves de pasaje de la era atómica que alborea.

~ 26 marzo 1958 ~

Juan B. ROBERT

In 1821 the "Post Boy" was fitted with a surface-condenser by David Napier, and the following year Brunel patented the same thing, but the year 1837 was when Hall applied it with success to the "Wilberforce."

It has been already related that in America and the Netherlands the compound engine was in use previous to 1830; 1840 was the first year that it was tried in England for marine purposes, when Spiller, of Battersea, fitted the "Era," a paddle-steamer, with compound engines working at 40 lbs. pressure, the diameters of cylinders being 17⅜ in. and 20 in., by 1 ft. 8 in. stroke. In 1854 Elder fitted the "Brandon" with compound engines, and in 1856 the "Valparaiso" and "Inca" for the Pacific Steam Navigation Company. This company must be largely credited with the introduction of compound engines. Their vessels were running where coal was dear, and any saving that could be effected was a matter of consideration to them, hence the trial given to Elder's two boats, and the success resulting therefrom was a great help to the upholders of the compound system. Elder also fitted the "Royal Bride" similarly in 1858, and she carried a supplementary surface-condenser as well.

× Historial del "Lima„, del 1851, en "S.R.S. Record„ 24 julio 1950-112.

Maudslay and Field in 1824 patented a brine pump to draw off from the lower part of the boiler a determined quantity of water, so as to take from the boiler as much salt as was deposited by the separation of the steam used each stroke, this hot brine being used as a feed-water heater.

Previous to 1844 flue boilers were in general use for navigation, but in that year the "Tagus" was fitted with tubular boilers, since which they have become the usual thing for marine boilers. Superheaters were introduced in 1859, the "Alhambra" being fitted in June of that year, the saving of coal amounting to 34 per cent. Centrifugal pumps were first used by Mr Appold in 1848, but it was more than twenty years later before they were much used in marine work. In 1856 Penn introduced lignum-vitæ for bearings in the stern bush.

In 1860 the Institution of Naval Architects was founded largely through the exertions of Dr Woolley, Scott-Russell, and Sir Edward Reed, and the work carried on by it and the similar Institutions of Engineers and Shipbuilders in Scotland, and the North-East Coast Engineers and Shipbuilders, have had a great influence on modern steam navigation.

From 1860 to 1865 surface-condensing marine engines with a pressure of 35 lbs. were the demand, the less fuel used and cleaner boilers having fought its way, and in 1866 the inverted type of compound engine with 60 lbs. pressure became general.

With the introduction and general use of screw-propellers, surface-condensation, and compound engines, the Early History of Steam Navigation ceases.

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